

Anatomical and Distributional Observations of some Opisthobranchs from the Panamic Faunal Province

BY

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(3 Plates; 1 Text figure)

KNOWLEDGE OF THE opisthobranch fauna of the Panamic faunal province has increased rapidly in the past few years. Nevertheless, much remains to be learned. Because of increased interest in these mollusks and greater ease of travel throughout the Gulf of California and the rest of tropical west America, researchers are reporting the finding of very rare animals more frequently and the occurrence of species hitherto unknown in this area.

This paper presents the results of our recent expeditions to the Panamic province, giving extensive new distributional data for 9 opisthobranch species, only 2 of which occur solely in the Panamic faunal province. Three of the species occur also in the Californian province, emphasizing again that on the species level the Panamic province is more closely related to the Californian province than to any other provinces (BERTSCH, 1973a).

To facilitate future comparative and functional morphology studies, scanning electron micrographs illustrate the radulae of 8 of the species.

Table 1 lists the location of each collecting site referred to in this paper.

Table 1

Latitude and Longitude of the Localities

Cholla Bay, Sonora, MEXICO	31°20' N; 113°37' W
Puerto Peñasco, Sonora	31°20' N; 113°40' W
San Felipe, Baja California	31°02' N; 114°49' W
Bahía San Quintín, Baja California	30°25' N; 115°54' W
Puertecitos, Baja California	30°21' N; 114°38' W
Puerto Lobos (Cabo Tepoca), Sonora	30°16' N; 112°51' W
Puerto Libertad, Sonora	29°54' N; 112°41' W
Bahía de los Angeles, Baja California	28°53' N; 113°30' W
Guaymas, Sonora	27°55' N; 110°53' W
Rancho Notri, Baja California del Sur	25°55' N; 111°20' W
Puerto Escondido, Baja California del Sur	25°49' N; 111°19' W
Isla Monserrate, Gulf of California	25°43' N; 111°03' W
Bahía San Marte, Baja Calif. del Sur	25°30' N; 111°01' W
Bahía San Carlos, Baja Calif. del Sur	25°16' N; 110°58' W
SE of Isla San Diego, Gulf of Calif.	25°10' N; 110°44' W
Punta Colorada, E. Isla San José	25°01' N; 110°34' W
Punta Prieta, W. Isla Espíritu Santo	24°25' N; 110°21' W
Punta Norte, Isla Cerralvo	24°22' N; 109°56' W
Las Cruces, Baja Calif. del Sur	24°13' N; 110°05' W
Bahía de Palmas, Baja Calif. del Sur	23°42' N; 109°42' W
Punta Colorada, Baja Calif. del Sur	23°35' N; 109°31' W
Pulmo Reef, Cabo Pulmo, Baja Calif. Sur	23°24' N; 109°26' W
Mazatlan, Sinaloa	23°11' N; 106°26' W
Sayulita, Nayarit	20°55' N; 105°25' W
Punta Mita, Nayarit	20°47' N; 105°00' W
Bahía de Banderas, Nayarit	20°46' N; 105°23' W
Los Cóbano, Sonsonate, EL SALVADOR	13°32' N; 89°48' W
Puerto Somoza, NICARAGUA	12°10' N; 86°45' W
Masachapa	11°47' N; 86°30' W
Pochomil	11°45' N; 86°29' W
San Juan del Sur	11°15' N; 85°52' W
El Ostional	11°07' N; 85°46' W
Bahía Jobo, Guanacaste, COSTA RICA	11°02' N; 85°45' W
Bahía Ballenas, Guanacaste	9°43' N; 85°00' W

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Stiliger fuscatus (Gould, 1870)

The taxonomic position of the genera *Stiliger* Ehrenberg, 1831, and *Ercolania* Trinchese, 1872, is still being debated. MARCUS & MARCUS (1956: 5 - 7; 1970: 39 - 40) considered *Stiliger* the valid generic name, with *Ercolania* merely a subgenus. However, because of the publication by BABA & HAMATANI (1970) of a redescription of the type species of *Stiliger*, MARCUS (1972a: 291; 1972c: 305) re-established *Ercolania* to full generic rank. More recently, THOMPSON (1973: 242) believed it inadvisable to raise *Ercolania* to a genus, proposing rather that the genus *Stiliger* include "species in which the penial spine may not always be present, the rhinophores may be digitiform or longitudinally grooved and in which the albumen gland may or may not enter the cerata." We follow Thompson's evaluation.

Stiliger fuscatus occurs on the Atlantic coast of North America, from northern New England to North Carolina (FRANZ, 1970: 174); at the tip of South America in the Estrecho de Magellanes (MARCUS, 1959: 22 - 24; listed as *Stiliger evelinae*; for synonymy, see THOMPSON, 1973); and along the southeastern coast of Australia. This distributional pattern becomes even more curious with the following new collection data from the northern end of the Gulf of California: On December 26 and 27, 1971, Ferreira collected 6 specimens of *S. fuscatus* a few kilometers north of Puerto Peñasco, Sonora, Mexico, in tide pools, under rocks that had been uncovered by the receding tide. They were found in pairs, and were observed copulating prior to their collection. The largest specimen measured 5 mm long while crawling.

The radular formula of one specimen was 10 (0·1·0). The distal portion of each spoon-shaped tooth (Figures 1 and 2) is concave anteriorly, with the lateral ridges fitting over the base of the preceding tooth; the tip of each tooth also fits into a sculptured cavity on the posterior face of the preceding tooth. Such a strongly spoon-shaped tooth suggests that the typical pierce-and-suck

feeding method of sacoglossans (e.g. GONOR, 1961: 88 to 89) may be augmented at times by a scooping action on the part of the radular teeth.

The occurrence of *Stiliger fuscatus* in tropical west America is certainly enigmatic. One can readily hypothesize a dispersal of this species by ship bottoms from the Atlantic American coast to the South American and Australian coasts, since these areas are (or have been) associated with international ports or shipping lanes. But any conjecture regarding the Panamic province occurrence would be extremely premature.

Polybranchia viride (Deshayes, 1857)

Synonym: *Phyllobranchillus viridis*. BERTSCH & SMITH, 1973: 168 - 169

KEEN (1973) stated that *Polybranchia* Pease, 1860, is not a preoccupied generic name, and hence the replacement names that have appeared in the literature are unnecessary.

The present recorded range of *Polybranchia viride* in tropical west America is from North Isla Cerralvo to the equatorial Galápagos Islands, with an intermediate collection at Punta Mita, Nayarit, Mexico (BERTSCH & SMITH, 1973). We have collected this species at additional localities in the Gulf of California, substantiating its more common occurrence in the southern Gulf region, and extending its range 225 km northward:

1. Rancho Notri, Baja California del Sur, Mexico; 1 specimen, 34 mm long; intertidally, underneath rock; leg. Bertsch, 23 December 1973
2. Puerto Escondido, Baja California del Sur, Mexico; 1 specimen; subtidally, 2 m deep, underneath rock; leg. Ferreira, 4 November 1973
3. Bahía de Palmas, Baja California del Sur, Mexico; 7 specimens; subtidally, 1 - 2 m, underneath rocks; leg. Ferreira, 18 - 19 November 1972

Explanation of Figures 1 to 6

Radula of *Stiliger fuscatus*

Figure 1: Lateral view of 3 teeth, in semi-erect positions × 300

Figure 2: Close-up of single tooth showing articulation patterns × 1000

Radula of *Polybranchia viride*

Figure 3: Lateral view of an entire tooth, and parts of adjacent teeth × 300

Figure 4: Anterior tip of single tooth × 3000

Radula of *Dolabrifera dolabrifera*

Figure 5: Lateral teeth approximately × 390

Figure 6: Close-up of tips of lateral teeth approximately × 1300
Scanning electron microscopy by Hans Bertsch



4. Punta Colorada, Baja California del Sur, Mexico; 1 specimen; subtidally, 1-2m, underneath rock; *leg.* Ferreira, 17 November 1972
5. Pulmo Reef, Cabo Pulmo, Baja California del Sur, Mexico; 9 specimens; subtidally, 1-2m, underneath rocks; *leg.* Ferreira, 14-16 November 1972

Descriptions and drawings by MARCUS & MARCUS (1970: 32) and BERGH (1871: plt. 12, fig. 3) of Caribbean specimens of *Polybranchia viride* match the radular morphology of our specimens from the Gulf of California. The teeth are thick, with blunt lateral denticles (Figure 3) and smaller anterior denticles (Figure 4).

PEASE (1860: 141) partially characterized the genus with the phrase "lobes deciduous." Our experience in dealing with living *Polybranchia viride* confirms the rapidity with which this animal autotomizes its cerata.

Dolabrifera dolabrifera (RANG, 1828)

Dolabrifera dolabrifera is a common, worldwide tropical and subtropical species (MARCUS, 1972b: 852). First recognized in the Gulf of California by BERTSCH (1970), at Las Cruces, Baja California del Sur, it has also been reported from Cholla Bay, Sonora, and Mazatlán, Sinaloa (both mainland Mexico), and from the Galápagos Islands (SPHON & MULLINER, 1972: 149). It is also very common intertidally in the Bay of Panamá (Bertsch and K. B. Meyer, personal observations).

Since then, Ferreira has collected *Dolabrifera dolabrifera* from additional localities throughout the northern and central Panamic province:

1. Puerto Escondido, Baja California del Sur, Mexico; 6 November 1973
2. Los Cóbano, Sonsonate, El Salvador; 1-2 February 1973
3. El Velero (near Puerto Somoza), Masachapa, Pochomil, San Juan del Sur, and El Ostional, all in Nicaragua (very abundant); January 1974
4. Bahía Jobo, Guanacaste, Costa Rica; February 1972

Two other species of the subfamily Dolabriferinae have been reported from the Panamic province: *Phyllaplysia padinae* Williams & Gosliner, 1973, and *Dolabrifera nicaraguana* Pilsbry, 1896. The exacting anatomical description by WILLIAMS & GOSLINER (1973) certainly validates the specific status of *P. padinae*. *Dolabrifera nicaraguana*, however, should be considered a synonym of *D. dolabrifera*. The older *D. dolabrifera* already has an extensive synonymy (*cf.* ENGEL & HUMMELINCK, 1936: 30-31). Although *D. nicaraguana* is not well known, a

comparison of the described anatomy with that of *D. dolabrifera* convinces us that the two are synonymous. The "unique characteristics" of *D. nicaraguana* fall within the range of variation known for *D. dolabrifera*.

Preserved Size: The length, width, and height of the 2 type specimens of *Dolabrifera nicaraguana* are matched by similar measurements of *D. dolabrifera* as reported by Engel and Hummelinck (see Table 2).

Table 2

Preserved length, width, and height of *Dolabrifera nicaraguana* and some specimens of *Dolabrifera dolabrifera* (sources: PILSBRY, 1896: 124; ENGEL & HUMMELINCK, 1936: 33-35) (measurements in mm)

	Length	Width	Height
<i>Dolabrifera nicaraguana</i>	40	21	16
	41	19	14
<i>Dolabrifera dolabrifera</i>	41	21	16
	40	25	15
	40	23	15
	40	28	13

Body Shape: Both *Dolabrifera nicaraguana* and *D. dolabrifera* are described by "Body plump, gradually narrowed in front, broadly rounded behind; sole very broad Dorsal slit far behind the middle of the body, and to the right, short, about one-fourth the length of body, gaping button-hole like at the ends" (Pilsbry's description of *D. nicaraguana*; compare with BERTSCH, 1970: fig. 1).

Body Ornamentation: Pilsbry wrote that *Dolabrifera nicaraguana* has its "surface smooth, or showing few scattered teat-like warts on the back." The number of wart-like dorsal papillae is variable in *D. dolabrifera* (personal observation), but their presence is diagnostic (KAY, 1964: 184).

Radula: The radula of *Dolabrifera nicaraguana* is unknown, not having been figured by Pilsbry. Our specimens of *Dolabrifera* from Nicaragua (including collections at the type locality of *D. nicaraguana*, San Juan del Sur) had a formula of 50-54 (140-170 · 1 · 140-170), and those from Costa Rica and El Salvador, 40-47 (120-135 · 1 · 120-135). The radular formula of *D. dolabrifera* is known to vary greatly; previously reported specimens have 28 to 160 teeth per half row (ENGEL & HUMMELINCK, 1936: 38). The outer lateral teeth (Figures 5 and 6) show the characteristic shape of dolabriferine and notarchine ap-

lysiids. These teeth have been variously described as "larger than serrated laterals" (BEEMAN, 1968: 94), and "long and narrow, the heads bluntly bifid; proximally the laterals have one or two small denticles on either side of the bifurcated central cusp" (KAY, 1964: 185).

Shell: The internal shell of *Dolabrifera nicaraguana* is described as "Shell solid, narrow (i), ... left margin more or less concave (ii). Outside concave, arcuate-striate, partly covered with a brownish cuticle (iii); inside heavily calloused (iv) and convex along the middle, white." (Pilsbry; roman numerals added by present authors). These features are also present in *D. dolabrifera*. (i) The "eigentümliche, längliche Gestalt" (ENGEL & HUMMELINCK, 1936: 37) of *D. dolabrifera* is well accepted. (ii) MARCUS (1972b: 853) writes that "the straight left border of the shell [of *D. dolabrifera*] is characteristic"; however, an examination of the shells figured ventrally by ENGEL & HUMMELINCK (1936: fig. 16) shows a left border more or less concave. (iii) The shell of *D. dolabrifera* is also covered by a brown periostracum (MARCUS & MARCUS, 1967: 39). (iv) The inner side of the shell of *D. dolabrifera* is "irregularly calloused (MARCUS & MARCUS, *loc. cit.*).

In their revision of the Aplysiidae, ENGEL & HUMMELINCK (1936: 41, 43) retained *Dolabrifera nicaraguana* as a valid species, based entirely on what they considered to be the uniquely different shell morphology of *D. nicaraguana*: 1) the lack of calloused bud, with only an irregular protuberance indicated; 2) different shell form, longer, bent, and not cornered. Except for the shell, they concluded, *D. nicaraguana* is entirely like *D. dolabrifera*.

We do not believe these differences between the shells sufficient for a separation of the 2 species.

First, PILSBRY (1896: 124) had already stated that the shell of *Dolabrifera nicaraguana* had an "apex with an irregular callus," and his illustrations (plt. 63, figs. 12 & 13) show this clearly.

Second, the width to length ratio of the *Dolabrifera dolabrifera* shells examined by ENGEL & HUMMELINCK fell within the range of 0.4 to 0.6 (MARCUS, 1972b: 852-853). The shells of *D. nicaraguana* illustrated by PILSBRY (1896: plt. 63, figs. 13 and 15) appear longer than the typical *D. dolabrifera* shell, having W:L ratios of 0.364 and 0.259. The W:L ratios of our *D. dolabrifera* specimens were: 0.43 (Puerto Escondido); 0.41 and 0.38 (El Salvador); 0.306 and 0.338 (Nicaragua); and 0.385 and 0.42 (Costa Rica). There is a continuous overlapping variation at the lower range of the W:L ratio of *D. dolabrifera*. Moreover, and most importantly, the W:L ratio of Rang's original *D. dolabrifera* (RANG, 1828: plt. 4, fig. 2; PILSBRY, 1896: plt. 34, fig. 13) was only 0.269. Hence, the W:L ratio of *D. dolabrifera* shells, amended to include Rang's specimens and Pilsbry's *D. nicaraguana*, varies from about 0.25 to 0.6. The illustration by Rang also shows that the shell of *D. dolabrifera* can be bent (although this may be a preservation artifact). Finally, the figured shells of *D. nicaraguana* appear to be "not cornered" because they are damaged shells, missing parts of the periphery (close scrutiny of Pilsbry's figure 13 on plate 63 reveals that the growth lines and the irregular edges substantiate our interpretation that these shells are incomplete).

Distribution: In conjunction with the above arguments, the finding of numerous *Dolabrifera dolabrifera* at the type locality of *D. nicaraguana* lends further credence to our suppression of Pilsbry's species.

We therefore conclude that *Dolabrifera nicaraguana* is a synonym of the wide-ranging and highly variable *D. dolabrifera*.

Hypselodoris agassizii (Bergh, 1894)

Researchers in the Panamic province have infrequently reported occurrences of *Hypselodoris agassizii*. It had been synonymized with *H. californiensis* (Bergh, 1879) by PRU-

Explanation of Figures 7 to 12

Radula of *Hypselodoris agassizii*

Figure 7: Outer lateral teeth

× 1000

Figure 8: Erect cusps of lateral teeth

× 3000

Radula of *Tayuva ketos*

Figure 9: Part of a row of laterals

× 300

Figure 10: Bases of lateral teeth

× 1000

Radula of *Aldisa sanguinea*

Figure 11: Lateral teeth

× 1290

Figure 12: Close-up of distal spatulate portion of laterals

× 3870

Scanning electron microscopy by Hans Bertsch



7



8



9



10



11



12

